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J. N. Allan, R.I.A., Secretary-Manager and Editor

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EDITORIAL

We have entered the year 1945 hopefully anticipating the conclusion of the European war, which, it is true, is but a step toward a complete victory over our enemies.

As we look toward that day of victory which will be the culmination of the most concentrated human effort in the history of civilization, we see beyond it a haze of uncertainty, for our vision is obscured by our inability to determine all the effects which must inevitably accompany the aftermath. We have read of the many conditions which are likely to exist after the war, of the great number of problems which must be faced and the solutions to these problems which are as varied as they are numerous. All of this but serves to confuse the mind of the one who would endeavour to anticipate the future and the course of coming events. It is well that we should strive to foresee our problems as far as possible and prepare ourselves for them, but it is also a wise thing to consider the past in the light of the knowledge which we may gain from experience. One of the things that experience of the past few years has taught us is that no individual, organization, country or nation is sufficient unto itself. We have learned that absolute faith in sound principles, mutual confidence one in another and free exchange of ideas is the safest course to pursue. It would, therefore, appear to be the better part of wisdom not to face these problems alone but to take full advantage of the mutual assistance which comes from close association.

This opportunity is available to the members of our Society through the meetings of the local Chapters. These meetings are planned to encourage open discussion of individual problems and provides the personal contact which can mean so much to the broadening of one's knowledge and understanding. There is an increasing interest being taken in the Chapter meetings which can only be construed as evidence of the benefit to be derived therefrom and it would behoove all members to utilize these advantages by their attendance as they face the critical days that lie ahead.

The library of the Society can be used effectively in coping with the various difficulties which arise. In this connection members are requested to feel free in writing the General Secretary on any problem which they may have and an effort will be made to supply helpful information or literature. The person who can intelligently make use of information based on the experience of others can save himself a great deal of unnecessary effort and thereby account for more effective work.

The time is rapidly approaching when accountants, cost accountants and industrial engineers must use all their resourcefulness, knowledge and ingenuity to prepare for the transition from wartime to peacetime operations. They must be able to project their reports to cover future operations rather than submit a record of what has transpired. They must be able to recommend and carry out efficient production and operating methods as their companies enter into a buyers' market with its close competition in

price, quality and service. That will be the time when the value of a cost accountant will be realized and his worth to his company will be recognized. During the past five year costs have been incidental, being required more or less for purposes of making settlements. They are now beginning to be treated with more respect and he who can provide management with the information for the control of this important factor will be rendering the greatest service.

It is to be hoped that the Society, through its various functions, may be the means of assisting its members in their preparation for the complex situations must be faced.

Our Society has just passed through a very critical and difficult phase and sincere tribute should be paid to those who rose to the occasion and assumed responsibilities which were thrust upon them so suddenly.

During the past few years, the Society has made remarkable progress under the direction of the late Mr. R. Dawson. The Society to-day stands as a monument to his untiring efforts and it was essential that this progress of the Society should be maintained. It was, therefore, very fortunate that such a man as Mr. L. J. Brooks, R.I.A., was willing to give of his time in administering the affairs of the Society until such time as a permanent appointment could be made. He had a difficult job to do and he did it well. All members will feel a great sense of gratitude for the very effective efforts put forth by Mr. Brooks.

Then, too, there must be remembered the members of the Dominion and Provincial executives. These men have been inconvenienced to no little degree when they have been called upon for assistance and advice in an endeavour to maintain continuity in the General Secretary's office.

Back Numbers Wanted

The following back numbers of Cost and Management are urgently required:

June, 1937	October, 1938
January, 1938	January, 1939
April, 1938	March, 1939

Any member who can spare any of the issues listed is urged to mail same immediately to the Secretary.

Appointment of Secretary-Manager

The Canadian Society of Cost Accountants and Industrial Engineers announce the appointment of Mr. J. Nelson Allan, R.I.A., as Secretary-Manager.

Mr. Allan was formerly Secretary of the Bay of Quinte Chapter of The Society of Industrial and Cost Accountants of Ontario.

J. NELSON ALLAN, R.I.A.

Chapter Notes

Bay of Quinte

A very interesting and lively meeting was held at the Quinte Hotel on December 12th with 30 people in attendance. The speaker was Mr. J. B. Boyce, President, J. B. Boyce Motors Ltd., who spoke on the subject "This One Pays Dividends."

The entertainment of the evening was provided by Ray and Les Lennox and Dorland Houston in very acceptable style. Another highlight of the evening was the presence of the Dominion President, Mr. E. J. Loiselle, L.C.M.I.

The next meeting of the Chapter will be held on February 7th and will take the form of a Foremen's Night. This will be a unique meeting in that it will be a joint meeting with the Superintendent's Association to which will be invited foremen and keymen of local plants. The speaker will be Mr. J. A. Lizotte, General Manager, Reliance Industries Ltd., and this meeting promises to be most interesting.

Fort William-Port Arthur

A social evening of the Chapter was enjoyed by the members on December 13th in the Royal Edward Hotel. The meeting was under the Chairmanship of Mr. W. E. Langford. An interesting program of entertainment was presented including tricks of magic, sleight-of-hand and ventriloquism.

Mr. W. Brander, Director of Training at the plant of the Canadian Car & Foundry Company showed motion pictures depicting action in the Pacific, Germany's invasion of France, the Low Countries and Norway.

Montreal

On December 8th, the Chapter held its regular meeting at the Mount Stephen Club and the speaker of the evening was Mr. S. D. Pierce, B.A., Bc.L., Chairman, External Trade Advisory Committee, Dept. of External Affairs. Mr. Pierce spoke on "Problems of External Trade in the Transition Period."

The meeting on January 12th was addressed by Mr. A. W. Gilmour, C.A., Supervisor, Corporation Section, Income Tax Department. The subject of the address was "Corporation Income and Excess Profits Taxes."

Mr. Alan Herrgen, Manager, Manufacturing Methods Division, R.C.A. Victor Co. Ltd., addressed the Chapter on January 26th. Mr. Herrgen spoke on the subject, "Work Simplification," Why and How.

Windsor

Twenty-eight members and 14 guests were present for the dinner and meeting held in the Norton-Palmer Hotel on December 15th. The meeting was addressed by Mr. W. P. Payne on the subject "Termination Claims and Renegotiation of Contracts."

In his outline of procedures, Mr. Payne very strongly stressed the necessity of a well-planned process in setting up a claim. This would afford an early submission and would allow the department to check facts with a greater ease and would promote an early settlement. In one review of a claim, Mr. Payne stated, its settlement as having taken 16 months for

completion that could have been handled in 3 months if all parties thereto had acted in the manner prescribed.

In "Renegotiation of Contracts", Mr. Payne stated that the authority allowing such renegotiations was vested in Section 13 of the M. & S. Contracts. Mr. Payne outlined the various types of contracts and stated that renegotiations are the consideration of the element of profit. This is classed as fair and reasonable and is usually 5%. The main point brought out by Mr. Payne in renegotiation procedure was the ability to supply adequate records to substantiate cost figures.

Vancouver

The regular monthly meeting of the Chapter was held on December 14th at the Georgia Hotel with the Chairman, Mr. Norman Terry, C.G.A., in charge.

Mr. N. J. C. MacKinnon, Chairman of the Educational Committee, reviewed the activities of the student group, stating that the number of active members was increasing.

Mr. R. McIntyre, Chairman of the Provincial Bill Committee reported that arrangements for putting the Bill before the Legislature were moving along satisfactorily.

The meeting was addressed by Mr. W. A. Dunfield of Boeing's Ltd. Mr. Dunfield gave a very interesting and informative talk on "Production Problems and Relationship to Cost Control."

New Members

Vancouver

J. M. A. LeMarquand, 510-511 Bank of Toronto Bldg., Vancouver.
H. E. Beyer, P.O. Box 337, Port Alberni.
H. M. Sutherland, 1845 Bayswater Street, Vancouver.
R. Humphries, 97 Commercial Street, Vancouver.
R. Genn, 612 Scollard Bldg., Vancouver.
Leo A. C. Donaldson, 3655 3rd Avenue West, Vancouver.
Murray Leith, David Spencer, Ltd., Vancouver.

Hamilton

Harold Richards, Treasury Representative, Otis-Fensom Elevator Co. Ltd. (Transfer from Windsor Chapter).
Chandler Bennett, John Bertram & Sons Ltd., Dundas.
Jerry Rosen, Dominion Foundries & Steel Co. Ltd., Hamilton.

Bay of Quinte

Harold B. Kellar, Stewart-Warner-Alemite Corporation, Belleville.

Kitchener

D. W. Bond, Silverwood Dairies Ltd., Kitchener.
Herbert G. Mahaffey, Moore Business Forms Ltd., Kitchener.
Ross Gordon, The Guelph Spring & Axle Co. Ltd., Guelph.
E. R. Scott, Babcock-Wilcox & Goldie-McCulloch, Galt.

NEW MEMBERS

R. A. Lewin, Sheldon's Ltd., Galt.
Grant M. Coles, Sheldon's Ltd., Galt.

Montreal

C. K. Barclay, Creswell Pomeroy Ltd., Montreal.
J. A. McColl, Campbell Glendinning & Co., C.A., Montreal.
F. J. Bastein, Davis, Boyce & Co., C.A., Montreal.
Marc Boyer, Corpn. of Professional Engineers, Montreal (Transfer from Quebec Chapter).
Phil Glanzer, Defence Industries Ltd., Montreal (Transfer from Toronto Chapter).

Edmonton

S. F. Morris, Dominion Income Tax, Edmonton.
Miss Mary M. Ferguson, Ferguson & Hurdley, Ltd., Edmonton.

Toronto

Ft.-Sgt. E. Lee Gosset, On Active Service with R.C.A.F.
W. J. Gray, City of Toronto, Dept. of Works.
J. R. Houston, The General Engineering Co. (Canada) Ltd., Scarboro.
F. G. Hawkins, Industrial Associates (Canada) Ltd., Toronto.

Windsor

Walter Woodruff, Truscon Steel Company of Canada Ltd., Walkerville.
Gordon S. Cole, Ford Motor Co. of Canada Ltd., Windsor.

Fort William-Port Arthur

James A. Aitken, Public Accountant, Port Arthur.
Wm. H. Leslie, W. C. Lille Real Estate, Insurance & Financial Agents, Fort William.
Louis E. Stephens, Emil Anderson Construction Co., Fort William.

Non-Resident

Frank E. Allan, Defence Industries Ltd., Nobel, Ontario.

Cost Problems and Cost Control in Construction

Address to The Canadian Society of Cost Accountants and Industrial Engineers — Vancouver, B.C., Chapter on November 9th, 1944

By V. E. FEIMANN, C.G.A.

Comptroller, British Columbia Bridge & Dredging Co. Ltd.

In the manufacturing industries cost studies have resulted in the evolution of several cost systems which may be briefly summarized as job costs — process costs — standard and budget costs. Their application according to prevailing circumstances and conditions has provided cost records suitable for production and management control. In the field of construction there are encountered problems which call for special consideration and cost treatment since they make it difficult to apply the systems as they have been developed for manufacturing industries. Confining ourselves to Heavy Construction in this discussion, the special problems to be faced can be traced to two main reasons, viz., the Location of the work and the Diversity of the jobs.

Construction work is usually spread over considerable territory with resulting difficulties of communication within the job area, centralization of stores and unification of controls. It becomes evident that this situation calls for careful adaptation of the cost accounting procedure if the cost thereof is to remain within reasonable and bearable limits.

Differences between construction jobs are usually very pronounced and render the adoption of a universally suitable cost recording system difficult if not impossible. Construction work differs from contract to contract in several ways. In the first place the scope of the work, the structures to be built and their layout vary considerably, quite apart from the geographical location. Secondly construction specifications are likely to be widely divergent: in plans, in materials to be used and in the manner of performing the work. In the case of a contract calling for work suitable in all details for the equipment and personnel of the Contractor, the job would be completed entirely with their own labour and equipment. With the exception of comparatively simple contracts, this may be considered the exception rather than the rule. In using the term "simple" it is not intended to convey the idea that such a contract would of necessity be small in value. The guiding factor here is the scope of the work, i.e., whether the contract calls for a diversified multiplicity of operations or not. As a rule some portions of the work are subcontracted, which means that more or less self-contained units within the contract are sublet to another company for completion. Such units may comprise the performance of labour only, or the furnishing of material sections only, or the combination of both labour and materials. A further variation is introduced in the event of the Contractor's equipment being insufficient for the entire performance of the work thereby necessitating the renting of equipment from outsiders. Finally the main Contractor may handle portions of the contract on basis of a Joint Venture with some other contracting firm.

We therefore find four principal variations in the performance of any one construction job:

1. Performance entirely with own labour and equipment
2. Sub-Contracting
3. Renting of Equipment
4. Joint Ventures

as well as combinations of these.

An additional controlling influence on the cost accounting system is provided by the form of contract. This may be a lump sum contract, a unit price contract, or a cost plus percentage or plus fixed fee contract. In a lump sum contract the contractor agrees to complete the specified work for a fixed total price and, unless he is asked during the construction to change the specifications materially, he will be paid the agreed total price. In a unit price contract the work is broken down into specific descriptions and quantities for which unit prices are established. Excavation of a certain quantity of earth, expressed as a number of cubic yards, at a determined price per cubic yard, would be an example. The contractor would then be paid for the total number of units completed at the agreed unit price. Cost plus percentage or fixed fee contracts are usually confined to Government work and are, of course, subject to the Government regulations established for these types of contract.

From this brief general outline of problems to be considered and met by the Cost Accountant, we may now progress towards stating them specifically with regard to Labour, Material, Overhead, Rentals and Sub-Contracts.

The correct labour distribution depends on an adequate time-keeping system and the problem immediately arises as to how to keep reliable time breakdown records for a considerable force of workmen spread over a large territory with frequent shifts in locality within the construction area. Among the various methods tried there might be mentioned three, i.e.:

1. Time Distribution Records kept by the Foremen.
2. Time Distribution Records kept by the Workmen themselves.
3. Time Distribution Records kept by a Timekeeper.

In the case of a comparatively small and compact job handled with a limited number of workmen, as for example in the construction of a medium sized wooden bridge, it might very well develop as the most suitable plan to have the foreman keep time for each workman and record the breakdown into the various desired work accounts. This is by no means an ideal solution but the size of the contract may not warrant the employment of a Timekeeper. It will become evident that the accuracy of time distribution in this case depends entirely upon the foreman's care and attentiveness to the timekeeping job. If for instance he should prepare the time records at night, or even at the end of a week, and make the entries from memory and his knowledge of the work performed, the result is more likely to portray an overall approximation than an accurate picture. The alternative of having the workmen keep their own time with the foreman certifying to their reports by countersigning them, while often resorted to, has serious disadvantages. In construction work the workmen are not only mostly in the open, but they often have to work in difficult surroundings, as possibly on structures high from the ground, in water

and so forth. They are also likely to be occupied during one day on a number of different phases of the job which, for cost control purposes, are to be kept separate from each other. Unless the different work sections are clearly understood by them and are easily separable one from the other, their reports will yield inaccurate figures. Where the size and scope of the contract permit it, the most reliable time reports can be furnished by an experienced timekeeper. He should not have to look after more than 150 to 200 workmen, and should be sufficiently familiar with the construction work engaged upon by them in order to analyze and record their work correctly. If, as an added control, the foreman of each gang keeps a time record of his men, this, in conjunction with the timekeeper's figures, would appear to provide an adequate labour cost breakdown to determine the distribution of labour over the desired phases of the job.

The control of materials and the distribution of material costs pose several problems. It must be borne in mind that in many cases it is both uneconomic and impracticable to erect a warehouse and to control the issuing of materials from a centralized store by means of requisitions. The well established inventory and material controls in manufacturing industries are, therefore, not easily applied to construction. Materials are ordered for the job from the Engineer's take-off sheets and for reasons of economy and work efficiency are, if possible, spotted throughout the construction area in order to make them easily accessible to the work sections for which they are required. There are, of course, cases when it is both practicable and desirable to stock pile materials or warehouse them on the job site. If delivery schedules cannot be arranged to coincide with requirements or if it is more economic to purchase supplies of certain materials in bulk, centralized storing can be maintained and issues from warehouse or stock pile controlled. Also some materials may have to be stored for protection. Even then, however, instances arise when correct determination of quantities and values as well as distribution is rather difficult. As an example there may be cited lumber and, in particular, shiplap. Foremen cannot always requisition form lumber in such a manner that correct distribution charges can be made. Also it requires considerable experience to estimate the footage in a quantity of shiplap with reasonable accuracy. A further complication is introduced by the question of re-uses. Form lumber may be used for casting floor slabs in one building and then re-used for a similar purpose in another building. The problem then is not only one of distribution between two or more buildings but also to keep track of such re-uses. Finally there may be mentioned the question of treating excess materials left over after completion of a job. Sometimes materials are specially designed and their use for other purposes may be restricted. Their correct valuation will of course be important in order to arrive at the job cost. It is not as a rule to be expected that appreciable quantities of special materials should be in excess, but this is nevertheless to be taken into account; for instance, if a change of design during the progress of construction should result in certain materials being replaced.

Under the heading overhead there have to be taken into consideration both job overhead and main office overhead. As job overhead there occur items such as superintendence, timekeeping, job accounting, moving

on and off job, transportation, and so forth. Main office overhead includes general engineering, estimating, control and general accounting, administration, etc. Some companies prorate job overhead expense over the job feature accounts by amortizing them monthly according to the accumulated cost values of the features. The value of this procedure would appear to be somewhat questionable. The two main purposes of the final cost statements are to determine the costs and to provide the engineer and estimator with a guide for future estimates. As a rule overhead is estimated separately and not as an integral part of the anticipated costs of job features. It may therefore be argued that no particularly useful information is gained by distributing job overhead to the features. As a matter of fact, for comparison and estimating purposes it may be preferable to keep the figures separate. This will become clear if it is assumed that a company engages at two different times in reasonably similar and comparable construction jobs, one of which being located close to the main office whereas the other might be some considerable distance away. Assuming further that labour and material costs bear comparison, it will become evident that any appreciable difference will lie in the overhead charge. The accounting for the first job may be conveniently conducted from the main office whereas for the second, the establishment of larger job offices becomes necessary; transportation costs will not be comparable, and so on. For the estimator it will then obviously be advantageous to know the cost result of the first job with the overhead separately shown.

The distribution of main office overhead to construction contracts is very difficult. Any such attempt would have to be based on rather arbitrary methods unless particular expenses can be clearly traced to any one job.

Equipment rentals will in some cases be an overhead cost and in others a material cost and are therefore mentioned separately. If owned equipment is used on a job, it is customary to charge the job with a fair rental. This is not only a correct item of construction cost but the procedure also facilitates comparison between using owned equipment and rented equipment.

There only remains the item of sub-contracts and its treatment. From an accounting point of view this is very similar to the purchase of materials and the only problem is one of setting out sub-contract cost in such a manner as to provide information for comparison with costs if handled with own labour and equipment.

It will be understood that this discussion of cost accounting problems in heavy construction has been kept in general terms touching only upon the principal questions. It may be of some interest to outline briefly and without attempting to cover the field in detail, a system of cost control and its operation as it may be established for a medium-sized lump sum or unit price contract. This will comprise the General Books, Ancillary Records and Forms, Cost Records, Operation of the Cost System and the Cost Reports, and it bears mentioning that this is only one of several possible variations and may not be suited to every type of construction work.

Reference to the General Books need only be brief and has the main purpose of pointing out the interlocking controls. It is a good plan to

list incoming invoices in an Invoice Register thereby providing a complete reference record of all vendors' invoices. An essential feature of such a register would be a record tracing the routing of invoices until they are returned to the accounting department for vouchering. The Voucher Register can be conveniently arranged in most cases to perform the functions of Voucher Register and Distribution simultaneously unless there are required such a large number of distribution columns that a separate record should be deemed desirable. Several of these distribution columns would be reserved for job cost control accounts to which further reference will be made when the operation of the cost system is dicussed. The Cheque Register can be combined with the Cash Receipts record since receipts and their entries are as a rule comparatively few in number. Outside of payments against sundry accounts, receipts against trade accounts are usually received on basis of progress estimates commonly prepared once a month. The General Ledger requires no discussion and, so far as the Cost Ledger is concerned, it will be dealt with in detail anon.

In regard to subsidiary records and forms, careful consideration will have to be given to the selection of suitable time cards and forms. When wages are paid weekly or semi-monthly and time is kept by a timekeeper, a cardboard form of a size so as to fit the pocket has been found satisfactory. This card can be punched to fit a standard pocket size folder. One card will be assigned to each workman for the pay period and is ruled for the days of the week or the dates of the pay period vertically whereas the horizontal lines are reserved for several work phase accounts. The distribution of each workman's labour is summarized at the close of the pay period on these cards. A discussion of forms to be used when workmen keep their own time records or when the foremen keep time can be dispensed with. It will likewise be unnecessary to dwell upon other labour records such as employment and earning records, payrolls, etc.

As for material records, the difficulties of centralized material control in a construction job have already been pointed out. With the exception of materials stock piled or warehoused, perpetual inventory records and control are impracticable. A control over materials is afforded by the engineer's take-off sheets and the engineer's reports of material in place. As a rule materials are not purchased for or sent out to, construction jobs in excess of requirements. One major difficulty in connection with material control is the question of securing reliable receiving reports. Shipments often arrive at the job site in large quantities within short periods of time and tallying and recording of receipts on forms prove impossible, particularly so if arrivals are spotted throughout the area. Much depends upon the experience of the checker and receiver and, in order that he may be able to keep up with shipments, it is often found to be the best method to have him countersign vendors' tally slips accompanying the shipments, as receiving evidence. The maintenance of detailed written receiving reports would in many cases necessitate a prohibitive increase of the receiving personnel.

Whereas these are not all of the required subsidiary forms and records, the principal ones and the ones creating special problems have been mentioned.

There remain but the Cost Ledger and Cost Report to be dealt with

in order to complete the discussion of the books and records. The cost ledger provides the very essential analysis of the cost breakdown into job phases. This ledger could be kept in the form of loose leaf ledger sheets, each sheet assigned to a job phase and showing for it, the cost of labour, material, sub-constracting, etc. However, it has been found very advantageous to use large columnar sheets on which columns are assigned to the various job phases, separately for labour, material, sub-contracting, etc. A sufficiently large space is also required for describing the item entered on each line. In order to keep these columnar sheets from being too unwieldy through the necessity of too many columns, a contract can be broken down into sub-controls. So could for instance a contract for several warehouses be subdivided to provide separate cost controls for each warehouse. The use of which columnar cost sheets has many advantages, such as ease of entering the items without having to leaf through a large number of separate ledger sheets, facility of summarizing the cost at any one moment and of proving the totals; the value of having all information together and of obtaining a composite picture of cost development without drawing up summarizing statements. From these cost ledgers or sheets are drawn the monthly cost reports which will be described in detail later on.

It may now be instructive to survey the actual operation of the cost system.

Most construction contracts are usually awarded to the lowest bidder against tender invitations issued by the Government Department or Organization which has construction work to let. By the way, this feature illustrates the fact that a Contractor must be of a rather optimistic disposition to engage in this branch of business. He can only secure work as a rule by tendering the lowest price, whereas it stands to reason that what we may term the "correct" price should lie about half-way between the lowest and the highest bidder.

In order to submit a tender, a complete cost estimate for the job is prepared by the Engineer. In this he breaks down the work into its job phases such as for instance forms, cement slabs, roofing, etc., and budgets for each job phase the amount of labour, material, sub-contracts (if any) and so on. The job overhead, also often called "General Conditions" is usually determined separately, and this includes Workmen's Compensation and all other insurance. In the event of the tender being successful and the contract being secured, this engineer's estimate forms the basis for the cost schedule.

Since Engineer's estimates are not always set up in the most suitable manner for cost accounting purposes, they are rearranged and cost symbols or numbers are assigned to the various job phases and further broken down into labour, material, sub-contracts and overhead. The estimate sheet so re-arranged and coded is a valuable document since it represents de facto the budget for the job and contains at the same time all information necessary to set up the cost accounts. If convenient, a new sheet is then prepared therefrom, eliminating all reference to quantities and prices and only listing the cost symbols or numbers with the job phase descriptions pertaining thereto and divided into Labour, Material, Overhead and Sub-Contracts, in this order. Of this cost symbol sheet copies are then pre-

pared for the Comptroller, the Cost Accountant, the Purchasing Agent and the Timekeeper. The Comptroller will set up the Control Account or Accounts for the General Books and the Cost Accountant can arrange his Cost Ledgers or Cost Distribution Sheets and is now prepared for the entries as and when he receives the posting media.

The labour charge to the Cost Distribution Sheet will be prepared from the extended time cards. On these the timekeeper has broken down for each man the labour distribution to the various job phase accounts by using the symbols from the cost symbol sheet. The Cost Accountant groups all labour charges under the respective symbols and makes his entries in the cost records from this summarization. The Control Account is charged from the payroll entry thus proving the total of the cost record labour charge.

The handling of material costs starts with the requisition on which the requestor states the purposes for which the material is needed. Upon making up the purchase order from this requisition the cost symbols representing the job phases for which the material is destined are entered thereon. When vendors' invoices are received and have been routed through the invoice register to the purchasing agent's department, the cost distribution is entered on them by using the same symbols. Upon obtaining satisfactory receiving evidence an invoice copy showing the coded distribution is sent to the Cost Accountant who charges his cost sheets therefrom initialling the invoice copy and returning it to the purchasing department. From there the full set of invoices with attached receiving evidence is forwarded to the General Accounting office for vouchering and payment. The charge to the cost control account is then made through the voucher register, thus again providing a check with the cost sheet material charge. Mention must here be made of those instances when it is very difficult or impossible to allocate a final cost symbol on the purchase order and the invoices relating thereto. This will be the case for instance when purchasing bulk quantities of form lumber since it cannot be determined at the time of ordering, or even at the time of entering the invoices, for which particular forms any predetermined quantity of this lumber will be used. It will then become necessary to set up clearing or inventory accounts by using special symbols and to charge such purchases into these accounts pending later re-distribution. One source of information for re-distribution will be secured from stock issue slips if material is stock piled or warehoused. Another, for instance in the case of re-uses, will be furnished by the periodic reports made by the engineer for material in place. A further complicating feature is that of the use of materials on the project for other than the purpose for which they were ordered. It happens frequently that foremen borrow from each other. As a rule, however, such dislocations are of temporary nature and right themselves in the end. Nevertheless, attention has to be given to this question so that extraordinary variances will be reflected in the cost accounts.

Charges to the cost sheets for Overhead will be made from time cards and invoices and also from entry slips forwarded to the Cost Accountant from the General Accounting office and will not be discussed in further detail here.

Charges for sub-contracts will be made from accounts rendered by

sub-contractors and verified by the supervising engineer with actual work performed.

This brief outline of the cost entries, their sources and their control through the General books will convey an idea of the operation of such a system. It has only been sketched in general terms and has but touched upon the principal features. Two special cost items may be added. One refers to extra work requested of the contractor over and above the contract specifications. This is known as force account work and force accounts are set up in the cost records where the value of such work is accumulated and from which it can be billed as a separate charge to the lessor of the contract. The other refers to substantial changes in design or specifications ordered upon the contractor during the work. This will not only result in variations of the contract price but also in the necessity of revising both the estimate and the cost set up in the books.

It will now have become clear that, unless a contractor engages only in one particular branch of contracting such as dredging or dirt removal work, there can be no universally suitable system of costs and cost records. For each separate contract the cost set up has to be so devised and the organization so arranged as to fit the particular contract. It is the Cost Accountant's job to provide cost information in such a form that it can be matched with the Engineer's estimate of the work.

At regular intervals, usually once a month, the cost sheets are totaled and summarized and a Cost Report is compiled. One form of cost report which has been found very useful is made up on large sheets providing the following information:

Engineer's Estimate for Labour, Material, Overhead and Total.
Estimated Quantities and Unit prices for the Contract.
Quantities completed to date.
Percentages of Labour, Material and Overhead completed to date.
Estimated Cost of completion to date (arrived at by applying the completion percentages to the Engineer's Estimate).
Actual Labour, Material and Overhead to date.
Actual Unit Prices to Date.
Variation in Labour, Material and Overhead expenditures as against Estimate Cost to date.

This information is shown for each job phase.

The Cost Report fulfils a fourfold purpose as follows:

It shows of course the cost to date, both for each job phase and the total.

It shows up clearly for each job phase the variation between estimated cost of completion to date and actual cost of completion to date, as well as the total variation. (This information is of particular value to the supervising engineer who can immediately investigate undue variations and take corrective steps).

It provides the necessary basis to make up progress estimates for submission to the lessor of the contract, since as a rule payment is made monthly to the contractor on basis of progress estimates.

And it furnishes information as to whether profit accrues according to estimate. This is of appreciable value if a decision is to be made whether or not to accrue profit on the books and to what extent. (The question of whether or not, when and how, to accrue profit on uncompleted contracts is a problem which merits careful study and will not be discussed here).

The final cost report drawn up on the same forms does not only convey a complete and illuminating picture of the completed contract but furnishes also valuable information for future estimates.

It is somewhat difficult to do justice to the entire subject of construction costs in a comparatively short address, but I may have conveyed an idea of the problems encountered and outlined a system which can provide the required information and controls. It will have become clear that this is in effect a form of budget cost system permitting of camparisons throughout the duration of the job and providing a yardstick with which to measure operating efficiency, to control cost and to gather data for future contracts.

Composite Fixed Variable Costs in Flexible Budgets

By I. K. DOWNER, R.I.A.

When installing a system of Variable Budgeting in a Company, while it is quite simple to segregate the fixed costs and the variable costs, considerable estimating is necessary on composite fixed variable items.

To eliminate this guesswork, and achieve an accurate segregation of the fixed and variable parts of these composite items, the following procedure is recommended.

Schedule Sales by months for one year in Column "A" and list monthly costs of the composite fixed variable cost in column "B". In column "C" list the figures in column "A" after squaring them, and in column "D" list the product of the figures in column "A" and the corresponding figures in column "B".

On a right triangle let the vertical side represent Sales Dollars and the base represent percentage of Sales.

Bisect the right angle with a line representing monthly Sales, and plot on this line a point for each monthly Sales figure. Then plot the corresponding cost for each month vertically with its corresponding Sales figure. Draw a rising line through these cost points, at an angle which follows the direction of the greatest number of these points. Drop from your schedule, any items which are represented by points so far removed from this line, as not to be representative.

Total all columns on the schedule and square the total of column "A". Multiply the total of column "A" by the total of column "B". Multiply the totals of columns "C" and "D" by the number of monthly periods remaining on the schedule.

From the resulting figures for "C" subtract the total of "A" squared, and from the resulting figure for "D" subtract the figure for the total of "A" multiplied by the total of "B".

The percentage of this second item to the first item, is the variable percent of the cost to Sales. Subtract this percentage of Sales from your total cost, and the balance of the cost is the fixed part of the composite fixed-variable.

This method of ascertaining fixed parts of composite fixed variables is correct down to about 25% of normal capacity of the plant, but below that point total costs drop sharply, due to the management taking special action to ensure this, and above a certain point, say 120% of normal capacity, they rise rather sharply because of the law of diminishing returns.

As proof of the foregoing procedure let us take a simple example:—

(The figures in italics are unknown).

Period	Sales "A"	Costs "B"	Fixed	Variable	"C"	"D"
1	4	5	*3*	*2*	16	20
2	6	6	*3*	*3*	36	36
3	8	7	*3*	*4*	64	56
4	10	8	*3*	5	100	80
	28	26	*12*	*14*	216	192

A x A 784 A x B 728 4 x C 864 4 x D 768

From 4 x C = 864 4 x D = 768

Subtract A x A = 784 A x B = 728

Difference 80 40

$\frac{40}{80} \times 100 = 50\%$ as Variable Cost of Sales.

50% of 28 = 14

26 minus 14 = 12 as Fixed Cost.

12 divided by 4 periods = 3 as Fixed Cost per period.

When using this method a Calculating Machine is essential because a Slide Rule does not give sufficient accuracy, and without a machine the manual work is so lengthy that it will cause the method to be abandoned.

Cost Accounting in the Canning Industry

With Special Reference to Tomato Products
A Thesis Presented to the Educational Committee, The Society of Industrial and Cost Accountants.

By OMER W. COX, A.C.I.S.

(Ed. Note: This thesis is published in two parts. Part II will appear in the next issue of Cost and Management.)

PART I.

INTRODUCTION

In this thesis the writer has attempted to discuss the methods and problems of cost accounting in the canning industry in general, and to illustrate the principles discussed with specific reference to the canning of tomato products, namely, whole pack tomatoes, tomato juice, tomato soup, and tomato puree. These products amply illustrate the problems involved in the application of the principles of joint costs to the canning industry.

No attempt has been to outline the practice now in use in any cannery, but rather to apply the principles of canning the above products to a hypothetical cannery. The conditions and figures are used only for the purpose of illustration, and are not intended to and do not reflect actual conditions. They are simply used to illustrate the methods or principles involved, and must not be considered in any other light.

All available literature on canning costs has been procured and reviewed, and references are made to the various articles throughout this paper. Divergent opinions and methods in use are discussed. The reference list at the end of this paper is referred to in the textual matter by the corresponding numbers in parentheses.

It is hoped that this paper will be of value to those engaged in the canning industry, and that it might in some small way further the cause of uniform accounting methods in the industry.

The writer wishes to express his appreciation for the opportunities provided for the preparation of this thesis by his employer.

DEVELOPMENT OF THE INDUSTRY

Canning is a process of preserving food by the use of heat and by enclosing it in airtight cans. This process was discovered by a Frenchman named Nicholas Appert in 1795. His method was similar to that used by housewives to-day, namely, the cold pack method by which the food was placed in glass containers which were immersed in water. The first understanding that heat sterilizes was given to the world by another Frenchman named Louis Pasteur, who is credited with its practical application to canning. Canning was first introduced into the United States in 1815, but little progress was made until 1840 with the development of fish canning. There was very little canning in the Central States until

tomatoes were canned near Cincinnati in 1860. Little impetus was given to commercial canning in Canada until after the turn of the century.

Of course at the beginning all the operation in canning were performed by hand, even to making the cans. The industry, however, has shared in the development of mass-production machinery. The old open-bath cookers required five to six hours at 212° F. for cooking many foods. The invention of the pressure cooker in 1874 solved this problem by reducing the cooking time to a matter of minutes. By the hand methods 200 cans an hour was considered good output, whereas a modern closing machine can handle from 12,000 to 18,000 cans an hour. The development of mass production methods with a wide range of varieties and sizes has brought about a corresponding problem of costing in the industry.

The development of the canning industry has had tremendous economic significance. It has changed the whole relationship between food consumption and agricultural seasons. Most fruits and vegetables in canned form are now available to the people at low cost at all seasons of the year, with much of their original freshness and flavour still intact and most of the food values remaining. The problem of food distribution and nutrition in centres of large population is simplified by means of canned foods. Farmers are provided with extended, dependable markets.

Canning factories are usually located in the areas producing the raw food products canned so as to reduce the time between harvesting and canning, thereby preserving the original qualities of the materials as much as possible. This factor is of prime importance in the industry, even with modern rapid transportation. In Canada the principal areas of production of vegetables and fruits are in Ontario, British Columbia, and Quebec, where the climate is favourable for growing the crops. The canning season in Canada begins in June and continues throughout the summer until October, being at its height in September.

THE MANUFACTURING PROCESSES FOR TOMATO PRODUCTS

The headings under which the manufacturing processes for tomatoes are outlined are in reality the production departments of the factory.

Receiving—The Receiving Department includes the functions of scheduling, inspection of loads, weighing, unloading, dumping, and attending to the scalder. The scheduling of tomatoes is done in close co-operation with the Crop Department for obvious reasons. The scheduler is responsible for ordering the raw tomatoes in so that an even flow of material is provided. This avoids undue waiting on the part of the truckers and prevents deterioration of the raw tomatoes that results from excessive holding before being put into process. The inspection determines whether the load conforms to the contract specifications, by taking samples and grading them. The weighmaster determines the correct weight (gross, tare, and net) of the load, providing a copy of the weight ticket for the trucker, the grower, the growers' ledger clerk, and a stub. This weight ticket is the basis of information for paying the grower as well as for the daily quantity of raw produce received for costing purposes. The tomatoes are unloaded and dumped into flumes that carry them into the scalder and thence to the subsequent processing operations.

Peeling—When the tomatoes leave the scalder they are carried on a

slowly moving belt, along which the peelers are stationed. They invariably reach for the choicest tomatoes, since they are easier to peel, as peelers are on piece work, being paid by the pail. This natural tendency alone insures that the highest quality tomatoes will go into the whole pack. Peeling is practically the only manual preparation required for tomato products. The peeling operation includes the removal of any undesirable portion of the fruit, should there be any, as well as the stem end.

Inspection—The pails of peeled tomatoes are dumped into an inclined trough and undergo a rigid inspection by the hand packers. At the ends of the peeling belt, there are two squads of inspectors who carefully remove any undesirable tomatoes or portions thereof.

Chopper—The tomatoes which do not go into whole pack and are still edible pass into a chopper machine which chops up the tomatoes.

Extractor—From the Chopper the tomato mass can be pumped into the extractor which further breaks down the mass and removes the seeds and peelings. This process is required only for tomato juice.

Pulp—The Pulp Department receives the chopped tomato mass through pipes from the Chopper Department, and the first step is the removal of seeds and skins as well as pulping the mass. It is then pumped into large pulp tanks in which it is boiled down to the required specific gravity for tomato soup or ketchup base or for puree. A Daily Pulp Report is prepared showing for each batch of pulp the starting and finishing time, the starting and finishing gallons, and the specific gravity. The total starting gallons is used as a factor in determining the absolute pounds of raw tomatoes used for puree and soup.

Soup—The Soup Department maintains mixing tanks where the ingredients for soup or sauces are mixed with the tomato pulp, and also provides holding and heating tanks for feeding the can lines.

Can Handle—This department attends to the receiving and unloading of cans as well as feeding the can lines. Cans may be unloaded into can storage or directly into the factory can lines when canning is underway. During the pack this is a continuous operation, as only a comparatively small quantity of cans is held in storage—enough to meet emergencies and to keep the various canning lines of various sizes in operation.

Hand Pack—The whole pack tomatoes are packed by hand, so that this department serves only one product.

Fill and Close—The operation of the filling and closing machines is the responsibility of this department. This includes the removal of cans from the machine and transporting to the retorts. The closing machines put the lids on and clinch the top so as to produce a sealed edge. A Daily Canning Report is submitted covering each canning line operated. It gives the commodity canned, can size, number of cans packed, numbers of cans spoiled by various causes, number of cans used for testing and sampling. This report provides information on total can usage by sizes for the Cost Department.

Retort—This department consists of the pressure cookers. Each cooker is an independent unit, operated by steam. It holds several baskets of filled cans, which are emptied and filled by an overhead crane. This department also is responsible for the cooling canal through which the baskets of hot cans pass in cold water. They emerge from the bath cool

enough to handle and case up in the warehouse. A Daily Report is made giving the starting and stopping time for each retort processed, for each size and product cooked. A recapitulation of this report gives the number of crates of each product item packed daily.

Case—This department covers the removal of the cans from the retort baskets and placing them in cartons.

Stacking—Hauling cases away and stacking them in the warehouse is the function of this Department. A Daily Warehouse Pack Report showing the actual pack in cases is submitted by the warehouse superintendent. He keeps a count of all cases stacked in the warehouse by product item and enters his recapitulation of this report. It gives the number of factory leaks, swells, and rusties discovered before casing which are not included in pack figures.

Service Departments—These departments are discussed in the section on indirect manufacturing costs.

THE PURPOSE OF COST FINDING

Determination of Selling Prices—The cost to make and sell has little direct effect on the selling price of goods over short periods is a recognized fact. The selling price is largely a matter of meeting competition, in so far as any given producer is concerned. Nevertheless, costs are instrumental in establishing general levels of prices over longer periods for the trade in general. But in the case of any particular manufacturer his costs do not necessarily govern his selling prices. The canning industry is no exception to these principles.

Diversion of Production into More Profitable Channels—An accurate knowledge of costs enables the manufacturer to develop his markets and divert production along the lines that give him the greatest margin of profit. Sound decisions in this respect are essential in the canning industry, since the season for fresh pack goods is quite short and when the pack is finished the supply of raw produce is absolutely cut off until another year. No further production of that product is possible until another year.

Instrument of Control—Since the cost per case of canned goods is fixed in the short space of time during which the pack is in progress, these are unalterable except for the shut-down expense which is practically in the same category. If waste and inefficiency are allowed to creep in and unduly enhance costs, the result may be selling the entire pack at a loss. There is no opportunity to average out costs during the remainder of the year, since no more can be produced until the next crop season. The control of costs by complete and speedy statements on materials and labour in particular is of prime importance in operating a canning plant.

Determination of Inventories—Inventory values are established on the basis of the cost accounts, covering the various products by sizes. Such information also permits the compilation of detailed gross and net profit statements broken down by commodity and size.

This subject is ably discussed by Ralph H. Barr (1).

THE SCHEME OF ACCOUNTS

The Process Cost System—Basically, food canning is a continuous process industry, and consequently uses the process system of cost account-

ing. Only certain features of the system are employed, however. The principal feature is the averaging of the total cost over all the product of the period. However, cannery cost accounting diverges from the process cost theory in that the costs do not follow the product from one process or department to the next. See Lawrence, page 299 (9). In food canning, direct raw materials and direct labour are costed entirely separately from manufacturing expense, in much the same manner as followed in the specific order cost system.

Joint Costs—A. M. Fox (7) says: "Joint costs are a phenomenon of production, whereby two or more products are obtained at the same time, in a single production process. The relationship between the joint products must be such that neither one of them can be obtained without the other." The canning industry is one in which joint costs are a major problem. The problem arises chiefly from the diversiefid and graded finished product resulting from farm produce bought at practically a flat price. Tomato canning ably illustrates an important problem in joint costs, since whole pack tomatoes, juice, soup, ketchup, chilisauce, puree, and sauce may be canned or bottled practically all at the same time in some plants. The greatest economy in the utilization of raw tomatoes is obtained when several tomato products are packed simultaneously. Another problem of joint costs arises from the fact that each product is usually packed in several can sizes.

Work-in-Process Inventories—Food canning requires the utmost haste from the time the perishable raw produce is harvested, through the various processing operations, to the finished product. The quality and nutritional values of the product are greatly affected by the time element. It goes without saying that at the close of each day's operations there are no partly cannd foods, no partly prepared foods. For this reason the problem of work-in-process inventories is almost non-existent in the canning industry. All materials, labour and overhead used in production are charged to finished goods.

Voucher Register—All expenses and costs are distributed through the Voucher Register which has separate columns for Raw Material and Supplies, Direct Manufacturing Costs, Indirect Manufacturing Costs and Warehouse and Shipping Expense. The totals of these columns are posted monthly to the General Ledger.

General Ledger Control—A separate subsidiary ledger is maintained for each manufacturing plant, under each of the single accounts maintained in the general ledger. A comprehensive scheme of general ledger controlling accounts is operated. The following tabulation shows the general ledger controlling account with an explanation concerning the subsidiary ledger opposite.

General Ledge Account	Subsidiary Ledger
Raw Materials and Supplies	Stores Ledger with an account for each item
Direct Manufacturing Costs	Subsidiary Cost ledger with a separate account for each element of direct cost for each product (all sizes combined)
Indirect Manufacturing Costs	Subsidiary Cost ledger with accounts for various elements of expense for

	each producing and service department
Warehouse-Shipping Expense	Subsidiary Expense ledger with accounts for various elements of expense
Growers Account	Subsidiary personal ledger with an account for each grower.

DIRECT LABOUR

Direct labour is all the labour performed in the production departments discussed previously in this paper. It constitutes all labour which actually handles the various raw materials personally or by machinery throughout all of the processing departments from the time the tomatoes arrive at the plant until the finished product is stored away in its place in the warehouse. Departmental supervision is included in direct labour; it usually has some part in the actual work. General supervision, however, is treated as indirect labour.

What is a Standard?—There exists a great deal of divergent opinion on what constitutes a standard cost, just as there are many different methods of arriving at the so-called standards in actual use in industry. Space in this paper will not permit a detailed discussion of this subject, and the writer will confine his remarks to a brief statement of his opinion on what constitutes an effective standard cost. A standard is an objective, and since it is an objective it should be an attainable objective, and not just a theoretical objective. It should be capable of attainment by the average workman at least seventy per cent of the time. This sort of standard serves as an incentive to workmen to increase their efficiency.

Setting the Standards—Owing to the seasonal character of most of the canning operations, and hence the necessity of training new operatives and workers each season (and nowadays oftener), the setting of standard labour costs is quite difficult. The standard labour cost per unit of output consists of two factors—the labour unit and the cost per unit. The cost per unit is more or less set for a long period, so that the chief variable factor is the output per unit of time. The use of time and motion studies in the setting of labour standards is recognized as the most scientific method. However, the results of time and motion studies must be translated into obtainable objectives. To do this past experience, considered in the light of anticipated changes in manufacturing conditions, must be calibrated by the results of time and motion studies. This method provides efficient labour standards for management as well as the cost accountant.

Departmental Output—Each producing department has a logical unit for measuring the output of the department. The standard cost per unit of departmental output is first set. The standard number of departmental output units per case of various sizes and products is multiplied by the standard labour cost per unit to obtain the standard labour cost per case. This is a general principle applying to all departments. Raw tomatoes pass through the receiving, inspection, chopper, juice extractor, pulp, soup, and hand pack departments, and the departmental output unit is pounds of raw tomatoes. For example, the standard number of pounds of raw tomatoes for 48-ounce juice is 57 pounds (as explained in the direct materials section of this paper). This figure is

multiplied by, say .000123 per pound for handling in a given department, the standard cost per case is .00701.

Peeling on a piece-work basis, by the pail. Can handle, fill and close, retort, and case departments are directly connected with the cans themselves, so that the standard labour costs in these departments are set after study of each can size separately, regardless of the product going into the can. The stacking department handles the filled cases, and the standard is set per case, varying slightly in the extreme sizes.

When all the labour standards have been set, they are tabulated by producing departments in a vertical column with the products and sizes in a horizontal column. The cost per case for each can size of each product is shown by departments.

Daily Direct Labour Cost—When a pack is in progress daily labour cost reports are necessary in order to control the utilization of labour in the various departments. The payroll department prepares a daiiy distribution of labour by hours and cost. These figures are compiled on the Daily Direct Labour Cost Report. Alongside these figures are placed the standard labour costs for the day's pack by departments. The latter are compiled by multiplying the standard cost per case in each product by the pack for the day, accumulating the several products in the calculator to give the total standard cost for the department. The total standard labour cost per case for each product item is multiplied by the cases packed that day to arrive at the total standard cost of each product item. These figures when cross added equal and are a check against the total standard costs by departments.

Labour Cost Ratios and Variances—The total actual cost as reported on the daily labour distribution is divided by the total standard cost for each department to give the ratio of actual to standard. These ratios are an index of departmental labour efficiency for the daily use of management in labour control. The variances of actual labour costs from standard are not charged to separate variance accounts under indirect manufacturing costs as is done in job costing. It is quite a simple matter to distribute these variances over the product items by department. When this method is practicable, as it is in the canning industry, it gives more accurate costing of products than transferring the variances to overhead. In the canning business too, seasonal conditions may cause wide variations from standard, so that the method explained is best suited to the industry.

Cumulative Direct Labour Cost—The Daily Direct Labour Cost report provides sufficient informtaion for daily labour control purposes. Each week a cumulative actual Direct Labour Cost statement is prepared by product item. The standard labour ratios are multiplied by the standard costs per case to give the actual cost per case of each product item by department. For example, the standard labour cost for 48-ounce juice is .00713 in the receiving department. This figure multiplied by the labour ratio of 93.71% gives the actual cost per case in this department for juice of .00668. The totals of the vertical columns in this report gives the total direct labour cost per case. This figure multiplied by the cumulative pack to date of each product item gives the total actual direct labour cost to date for each product item. These latter figures provide the information

for the payroll distribution journal entries covering the pay period. The various products are charged with the actual direct labour cost in the subsidiary ledger for direct labour.

DIRECT MATERIALS

It is a general practice in the canning industry to divide direct materials into several classifications because of the importance of each in the cost and the consequent necessity for adequate control.

Stores—A stores ledger is maintained for raw materials and supplies controlled by a General Ledger account. Perishable raw materials are not charged to stores for the reason that there is seldom any inventory, except perhaps a small carry-over from one day to the next. All other raw materials are charged to stores. A separate account is kept for each item by size, giving quantities and values. The stores ledger is not strictly speaking a perpetual inventory record. The usage of each item is entered at the close of each period, and then it is the actual usage and not the reported usage that is entered, leaving the actual inventory as the balance carried forward. The reason for this procedure is that actual inventory reduction is charged to the various products using the item in proportion to the standard usage for each product.

Material Valuation—A modification of the average cost method is used in valuing materials. Since the stores ledger is not operated as a perpetual inventory and usage charged out daily, only the purchases are entered as received from the purchase vouchers. At the end of the month or after the pack the total purchases plus the beginning inventory values are divided by the corresponding total quantity to get the average cost per unit. This unit cost is used in charging usage to production for the preceding period. A new average is used each period if there have been price changes.

RAW PRODUCE

Raw Produce covers all raw farm produce which forms the basic raw food material, such as vegetables, fruits, fish, etc.

Yield of Farm Produce—The farmer and the canner have one important thing in common. If the farmer has a good crop of high-quality then the canner also has a corresponding pack of canned goods. If the farmers' crop is smaller than anticipated, the canners pack is also smaller than budgeted for, and his operations are consequently curtailed. The fact that a certain acreage is contracted for does not in itself guarantee a supply of raw produce to can. A certain pest might attack the crop and render the yield negligible, to the extent that canning operations would be impossible. The constant vigilance and research of the Government Departments of Agriculture have materially reduced this hazard. The weather, particularly at planting and harvesting times, is an important factor in crop yield and quality. There is nothing much that can be done about this factor, except learn to live with it. The date of the last spring frost and the first fall frost govern the length of the growing season. A prematurely early frost would suddenly stop canning operations, perhaps several weeks before expectations in the case of fall crops. Growing several varieties with as wide a range as possible of varietal maturity aids greatly

in extending the canning season at both ends. For these reasons, any estimate of the tonnage of farm produce to be received or of the resultant pack by grades, is very difficult and may vary extremely from the actual in either direction.

Wastage—Wastage of raw farm produce is the difference between the quantity actually bought from the farmer and paid for and that which actually gets into the can as finished product. This wastage arises in several ways, as follows:

1. Evaporation between time produce is weighed over the scales and time it starts in process.
2. Unsatisfactory pieces or portions removed by inspectors as tomatoes move along peeling belt.
3. Excessive loss resulting from careless handling of tomatoes.
4. Machinery breakdowns resulting in spoilage of raw tomatoes.
5. Peelings and stem-ends removed for whole pack tomatoes.
6. Seeds, peelings and other portions removed in manufacture of juice, soup, and puree.

Loss of weight by evaporation is largely unavoidable, and depends upon the air temperature and proper scheduling so as to avoid any large stock of raw tomatoes on the receiving platform at any one time. The grade tomatoes received is the chief factor in the amount of raw material removed by the inspectors, and this in turn may be the fault of the season or of the individual grower. Any load of tomatoes which upon sample grading passes the minimum average grade is accepted and paid for.

These features are discussed by F. R. Bear, reference 4.

Defective, Spoiled, and Waste Materials—In job cost accounting defective or spoiled work is charged to a similarly captioned account in manufacturing overhead, and the cost of the job is relieved of the cost of materials, labour, and manufacturing expense already expended on the spoiled work. (Lawrence 9, page 398). The canning industry, in adhering to the process cost system, treats all spoiled work as an additional cost of the good work. This is not done on a departmental basis, as in theoretical process cost accounting (Lawrence 9, page 305). Raw materials and direct labour are charged directly to the product as separate items in the same manner as in job costing. For this reason, the cost of cans is the total cost of the can usage for example. In setting up standards for raw materials, normal allowances for spoilage are provided. Peelings, stem-ends and seeds are fairly constant wastages which are inherent in the product. Spoilage resulting from carelessness and machinery breakdowns are extraordinary losses which should be largely controllable.

Setting the Usage Standards—When the time nears for commencement of canning operations, a thorough check is made of each field of tomatoes by the Crop Department, and an estimate of harvesting period, quality of tomatoes, and yield per acre is made and summarized. From this information the canner can make tentative plans for the anticipated volume of production and the approximate date of commencement. Based on this information an estimate of wastage due to the quality of the tomatoes as received from the growers can be made. Added to this is the unavoidable wastage and an allowance for carelessness and accidents. After carefully reviewing all of these factors and relating them to past experience

an anticipated percentage of wastage is set as the standard wastage. The laboratory has established what is called the absolute usage of tomatoes; that is, what actually gets into the cans. The standard wastage is applied to this figure to give the standard usage per case. Wastage in tomato products may run from 15 to 50 per cent to give the reader an idea of the importance of raw produce control.

Differential Cost per Pound—Most raw produce used in canning is purchased on a flat price per ton, but sometimes on a grade basis. On the other hand, canned goods are usually put up into several grades. These grades, however, seldom have a close bearing on the grades of raw produce purchased. For this reason, even though the raw produce is purchased on a grade basis, the costs of the various grades cannot automatically be charged to the corresponding grades of the finished canned product. There are several factors which affect the final grades of a canned product besides the grades of raw produce purchased. The final grade of some products cannot be definitely determined for ten days to two weeks after they are packed.

If we charge all grades the same price per pound of raw produce used, then the lower grades might show little profit or even a loss, while extraordinary profits would be attributed to the higher grades. This condition would not reflect the true state of affairs. If the lower grades were not utilized in production, (and they usually must be bought along with the higher ones) then the higher grades would have to bear the entire cost of the discarded lower grades. For this reason, when the lower grades are used in production, they should bear only a reasonable fraction of the average cost per pound. The problem, then is to select an equitable basis for apportioning the raw produce cost so that the products using the higher grades will bear a relatively higher cost than those using the lower grades. George R. Keast (8) says: "Broadly speaking, the cost of ungraded raw product should be apportioned to the resulting grades of canned goods on a sliding scale approximating the price range which would exist if it were possible to buy perfectly graded raw product and pack it accordingly . . . Grade differentials, frequently known as ratios of values, are nothing more than schedules showing relative values. Their purpose is to make each grade share the raw product cost roughly in proportion to its "ability to bear."

These features present one of the greatest problems to the canning industry in the application of the principles of joint costs to products. The generally accepted theory is that the selling price itself causes value to be given to a product, and that therefore the cost of the raw produce used in the various grades take their relative values from the differentials in the selling price. Practically all writers on canning costs treat this subject, with slight variation in opinion. The objection to this theory is that many other factors are at play which affect the selling price, especially if other ingredients vary according to the grade. Even if we deduct all other costs except raw produce from the various selling prices, in order to establish relative sales values that exclude other costs, we still have to contend with other forces which affect the relative selling prices. For this reason the theory of establishing grade prices per pound for raw produce on the basis of selling prices is not a perfect theory, but at least

Exhibit 6

Standard Differential Price of Raw Tomatoes

Product	1 Relative Price	2 Converted Case to Be Packed %	3 Standard Pounds Per Case	4 Relative Pounds To Be Packed (2x3)	5 Relative Cost (1x4)	6 Actual Cost Prorated	7 Standard Differential Price per lb. (6÷4)
Tomatoes	1.00	50	45	2250	22.50	21.23	.00944
Tomato Juice	.80	30	45	1350	10.80	10.19	.00755
Tomato Soup	.60	15	100	1500	9.00	8.49	.00565
Tomato Puree	.60	5	180	900	5.40	5.09	.00565
Total		100	391	6000	47.70	45.00	.00750

Exhibit 7

Raw Tomatoes, Standard Cost per Case

Product	Size oz.	Cans Per Case	Absolute Pounds Per Case	Standard Waste at 50%	Standard Pounds Per Case	Standard Cost Per Pound	Standard Cost Per Case
Tomatoes	15	48	43	21.5	64.5	.00944	.60888
	28	24	44	22	66	.00944	.62304
	105	6	40	20	60	.00944	.56640
Tomato Juice	10	48	30	15	45.0	.00755	.33975
	20	24	30	15	45.0	.00755	.33975
	48	12	38	19	57.0	.00755	.43035
	105	6	40	20	60.0	.00755	.45300
Tomato Soup	10	48	66	33	99	.00565	.55935
Tomato Puree	105	6	140	70	210	.00565	1.18650

it furnishes a somewhat reasonable basis for allocating raw produce costs to the grades packed, especially when modified by an injection of sound judgment.

If there is any means of obtaining reasonably consistent prices of the various grades on the open market, these can be used as the relative prices, but no doubt they would have to be adjusted. Even an arbitrary relative price per pound may be employed, which would reflect the differentials of the selling price and the open market grade prices. No matter how the relative grade prices are set the method of computing the cost per pound of raw produce used in the graded finished produce is the same.

This paper is referring specifically to tomato products, and for this reason these products are used in the illustration of the principle of grade costs. Tomato soup and tomato puree are not graded products, and they can utilize approximately the same quality of raw produce. Tomato juice put up in the plants the writer is familiar with is all of the fancy quality. The whole pack tomatoes, however, do come in more than one grade, even though the highest percentage of fancy quality is sought. The second and third legal grades in Canada are choice and standard, respectively. In order to simplify the problem for illustration, we shall assume that tomatoes are packed in one grade, but all three grades can be handled by simply extending the principles outlined. Only the highest quality, firm, whole tomatoes are used for the whole pack. The problem in grade costing raw tomatoes, then, is by product.

For the purpose of this illustration we shall assume that after thorough study of the inter-play of sales price and market price of raw tomatoes we have established the relative prices set in exhibit 6. With tomatoes at $1.00, then juice would be 80 cents and both soup and puree 60 cents. The next factor is the estimated pack, which we have expressed in percentages, but may be thought of as number of cases. Since the various products contain different quantities of raw tomatoes per case, we must then compute the total relative pounds per case by multiplying column 2 by 3 to give 4. The product thus given is then multiplied by the relative values in column 1 to give the total relative values in column 5. The total cost to account for is 6000 relative pounds at .0075 per or $45.00 as shown in total of column 6. This amount is prorated over the products applying the ratio of actual to relative cost to the relative costs in column 5. This ratio is computed as follows:

$$\frac{4500}{4700} = 94.34\%$$

The differential price per pound (column 7) obtained by dividing the actual prorated cost (column 6) by the relative pounds for each product (column 4).

There are two further steps in arriving at the standard cost per case for raw tomatoes. We have the standard usage, which is 50 per cent of the absolute pounds per case as shown in Exhibit 8 added to the latter to give the standard pounds per case. These pounds for each product item are multiplied by the standard cost per pound as developed in Exhibit 6. This computation is illustrated in Exhibit 7.

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